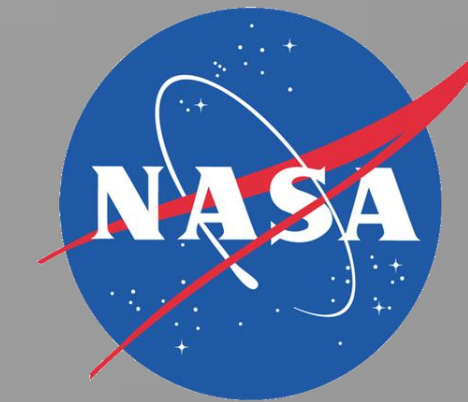


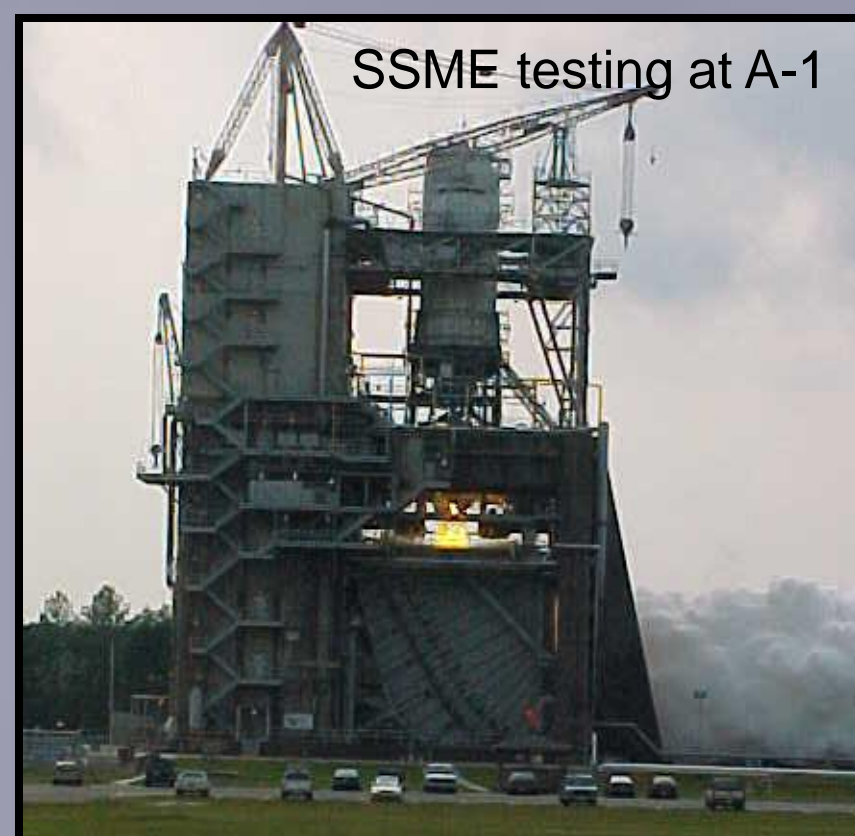
ENGINE GIMBAL REQUIREMENTS FOR GROUND TESTING OF J-2X



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ER-21 Mentors: Joe Leahy, Karl Nelson, Rebekah Howe



J-2X Engine Test Facilities



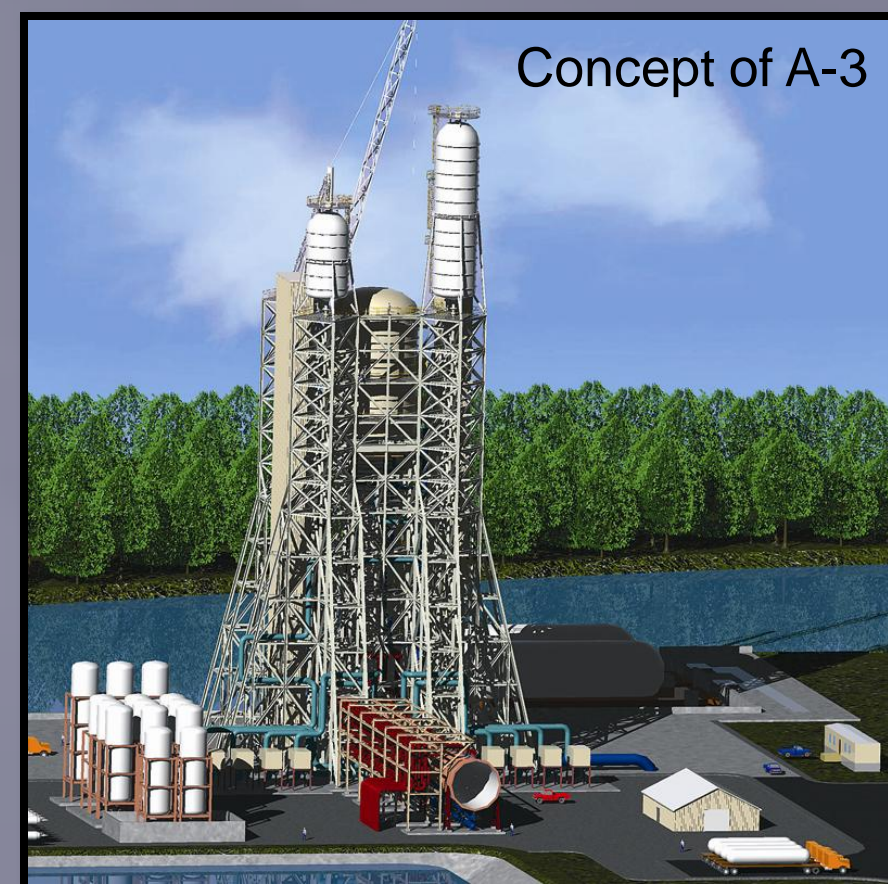
SSME testing at A-1

A-1 Test Facility

- Built during Apollo era for J-2 testing
- Currently being remodeled
- Sea level test stand, no altitude simulation
- Regen nozzle only
- Primary power level only
- Feedline clocking same as US
- Unlimited gimbal dwell

A-3 Test Facility

- Designed specifically for J-2X testing
- Currently under construction
- Altitude testing to .16 psia
- Full nozzle extension
- Primary and secondary power level
- Feedline clocking different than US, under review
- No gimbal dwell



Concept of A-3

J-2X Component Gimbal Requirements

General

- Duty Cycles
- Induced Environment

Gimbal Bearing

- Verify 5 degree gimbal pattern
- Verify gimbal rate of 5 deg/sec

Inlet Ducting

- Measure pressure drop over inlet ducts at fully gimbaled position at both power levels
- Examine flow induced vibration at various gimbal positions

Turbomachinery

- Verify environment by gimballing slowly in largest allowable circle at both power levels and at extremes of run box

Combustion Devices

- Verify Main Combustion Chamber and joint between regen nozzle and nozzle extension by gimballing to worst case stress patterns determined by analysis

Lessons Learned

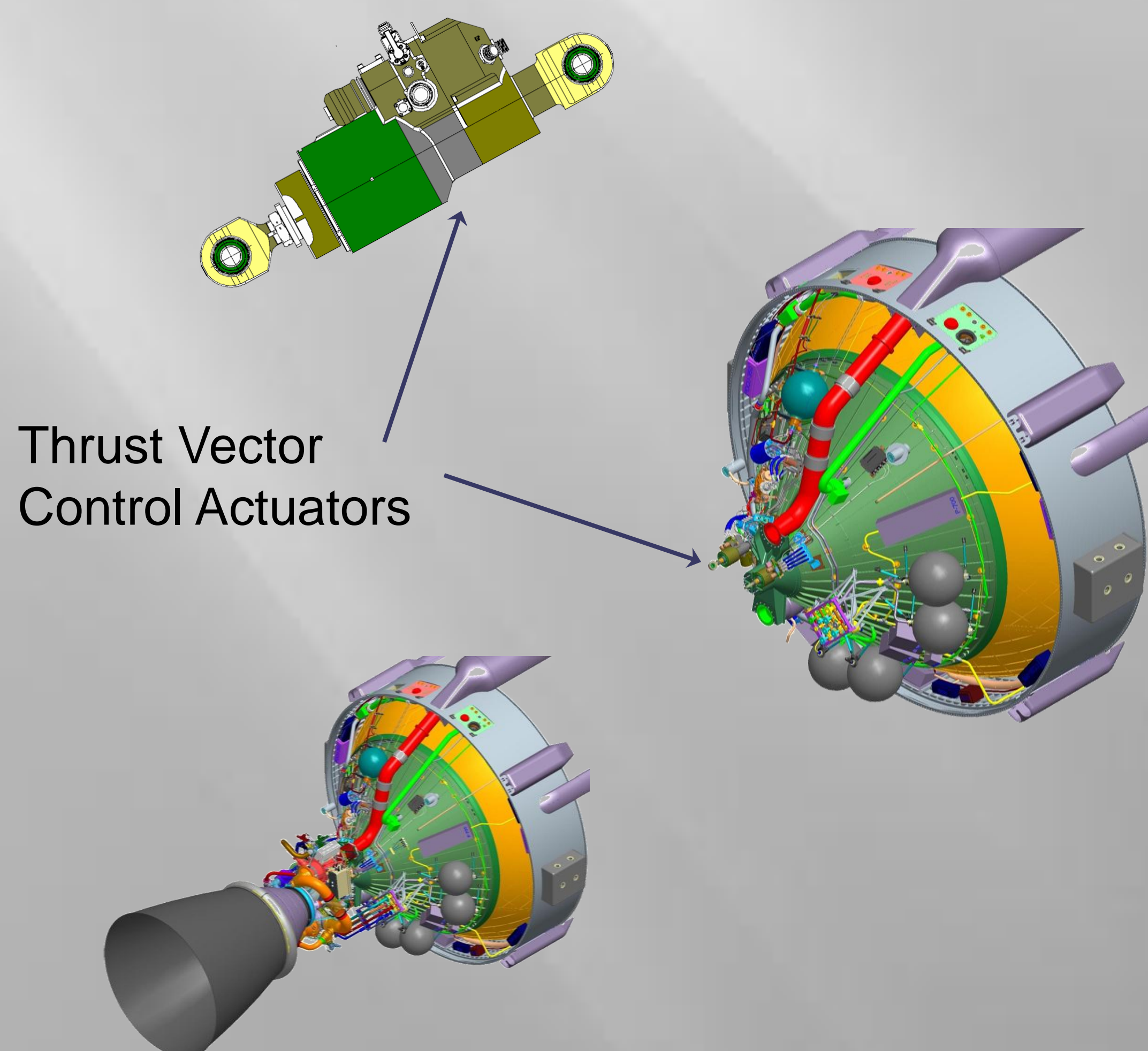
- J-2
- SSME
- RS-68

Detailed Verification Records

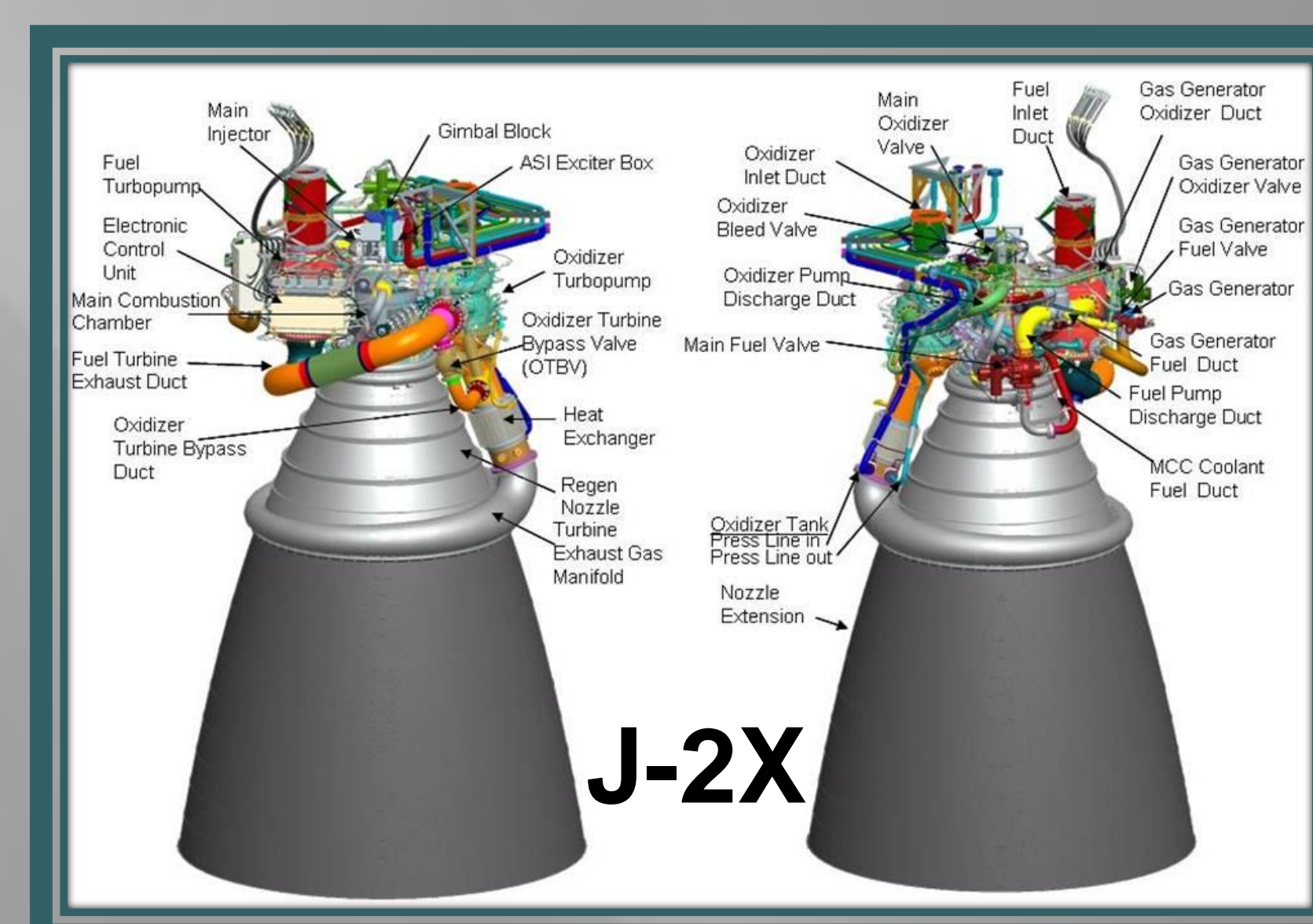
Test Plans

Stennis Facility Requirements

- Pattern
- Rate
- Drift
- Dwell
- Hydraulics
- Controls



Thrust Vector Control Actuators



J-2X



A-3 construction progress